6. Operations

Wastewater reuse facility operations need to be performed in a manner that addresses the following aspects of operation:

- Pretreatment
- Lagoons
- Grazing
- Buffer Zones
- Protection of Domestic and Public Well Water Supplies
- Site Closure
- Weed Control

Considerations for each of these aspects of reuse facility operation are discussed in the following sub-sections.

6.1 Pretreatment Considerations

The degree of pretreatment is site and wastewater specific and can generally be separated into considerations for *municipal wastewater* versus considerations for *industrial wastewater*.

The main consideration with respect to land treatment, however, is whether the soil-crop system can treat the wastewater in question:

- In some cases, the land treatment area does not have the capacity to treat the wastewater without pretreatment to reduce a land limiting constituent.
- In other cases, typically involving industrial wastewater, a change in the processing method can significantly reduce the concentration of the land limiting constituent. This reduction in concentration could make increased loading and treatment of wastewater possible, up to the point where the next land limiting constituent loading threshold is reached.

Regardless of the reason for pretreatment, these processing changes are evaluated as to their cost effectiveness in terms of the land area needed, the cost of making a process change, and the efficiency realized from a process change. Ultimately, more than one land limiting constituent may need to be reduced to allow higher loading rates.

6.1.1 Municipal Pretreatment

The primary concern regarding municipal wastewater treatment by land application is the potential health risk due to the presence of disease causing organisms. Most municipal wastewaters require pretreatment that reduces indicator organisms prior to land treatment.

The degree of pretreatment needed depends on three factors:

- The type and intended use of the crop
- The method of wastewater application
- The extent of public access and exposure

Specific coliform treatment requirements for direct use of municipal wastewater are found in the *Rules for the Reclamation and Reuse of Municipal and Industrial Wastewater* (IDAPA 58.01.17.600.07).

Exceptions to the treatment requirements can be considered when it is demonstrated that the exception will not adversely impact protection of the public health and safety. See the waiver process in IDAPA 58.01.17.940.

6.1.2 Industrial Pretreatment

Pretreatment for industrial wastewaters tends to involve the additional treatment or removal of organic constituents, suspended solids, nutrients (such as nitrogen and phosphorus), metals, toxic compounds, and, in some cases, salts before the wastewater can be land-applied. Industrial pretreatment processes also tend to be more variable than municipal wastewaters because there is often more diversity of critical wastewater constituents in industrial wastewater streams.

In most cases, pretreatment of industrial wastewater depends how cost effective the treatment is. For example, in a situation in which pretreatment could reduce the land area needed, the savings achieved from using less land must be balanced against the additional costs of pretreatment.

Disinfection of industrial wastewaters is generally not required if it is known by knowledge of process that there are no sanitary sources of microbial contamination (consisting of pathogenic microorganisms from human sources) in the waste stream. There are cases where pathogenic organisms are present in industrial wastewaters from non-sanitary sources, and their risk to human health must be assessed. Methodologies for determining the risk of microorganisms in land applied wastewater are under development by DEQ. See Section 3.4.9 for further discussion of pathogens and microbial risk assessment.

6.2 Not used at this time

6.3 Lagoons

This section discusses the purpose and need for wastewater treatment and storage lagoons at wastewater reuse facilities, design requirements for lagoons, their construction, seepage criteria, and operation and maintenance.

6.3.1 Lagoons: Purpose and Need

For some land treatment systems and reuse systems, treatment and/or storage lagoons may be needed. Treatment lagoons are needed to reduce wastewater constituents through secondary, or biological, treatment, as well as settling of solids, or primary treatment.

Storage lagoons are a second type of lagoon. The volume contained by these lagoons can vary from as little as one day's flow to as much as six months or more. Determining the required volume depends on such factors as the influent flow rate, precipitation, evaporation, safety requirements, and other considerations.

Storage requirements can be reduced, or in some cases eliminated, by providing alternative backup measures, as determined on a case-by-case basis, such as additional land treatment acreage, or the ability to vary a facility’s production and wastewater generation rates.

Storage lagoons may be needed when:

- precipitation causes excessive hydraulic loading,
- cultivating practices prevent wastewater application,
- winter weather precludes operation or a reduction in the rate of application,
- flow variations in quantity and quality require equalization, or
- when an emergency backup for the treatment system is required.

6.3.2 Lagoon Design Criteria

Design criteria for municipal and industrial lagoons are based on the *Recommended Standards for Wastewater Facilities – 2004*, otherwise known as the ‘Ten State Standards’, published by the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers. See IDAPA 58.01.16.007, 008 and 493.

Rules for seepage allowances for design of new municipal lagoons are found in Idaho’s *Wastewater Rules* (IDAPA 58.01.16.493.03a). These criteria require lagoons be designed with a seal having a seepage rate less than 500 gallons/acre-day (0.018 inches/day).

6.3.2.1 *Lagoon Construction*

Lagoons are generally designed and constructed with earthen dams or dikes. The inner dikes of new lagoons are typically lined with a synthetic material to prevent leakage. Figure 6-1 shows a typical lagoon design. To allow mowing of the outer banks, outside slopes are usually no more than 3 units horizontal to 1 unit vertical for slope stability and maintenance. Lagoons must be designed for a minimum *freeboard* (the distance between the top of the dike at its lowest point and the highest allowed wastewater level within the lagoon). This provides a safety factor for wave action, higher than planned wastewater generation rates, or heavy precipitation events. For existing lagoons utilizing clay or earthen liners or lagoons that have a buried synthetic liner, the inside slopes may be protected by riprap from 1 foot below the minimum water surface to the top of the freeboard to protect against wave erosion.

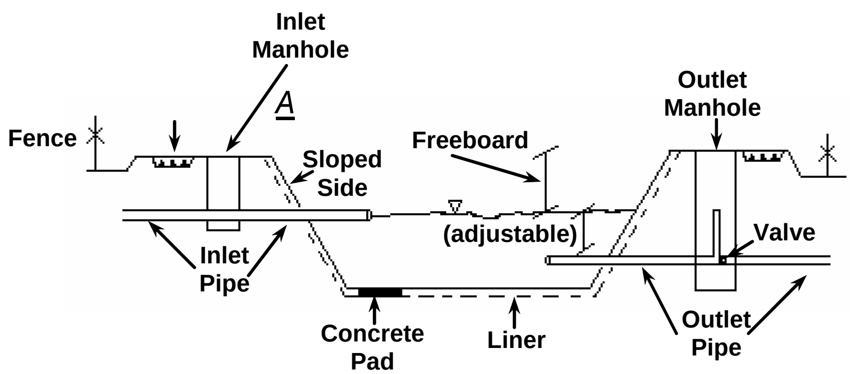

Figure 6-1. Typical lagoon design. [From Wastewater Stabilization Ponds, 1981]

Design requirements for new lagoons are meant to minimize seepage losses of the stored effluent. Liners are used to minimize the loss of wastewater to the subsurface or ground water by reducing the permeability of the bottom and sidewalls of lagoons. The typical materials used for liners are synthetic membranes, compacted clay, and bentonite. New installations typically use synthetic membrane liners such as HDPE (high density polyethylene) or buried PVC (poly vinyl chloride) liners. Clay and bentonite liners require submergence in water to retain their sealing characteristics. If exposed and dried, clay and bentonite liners may develop cracks and lose their ability to provide a good seal.

Wastewater enters and leaves a lagoon through inlet and outlet pipes. Inlet structures should be located so that wastewater is distributed evenly in the pond. If wastewater is gravity fed to the lagoon, a concrete pad or riprap is often placed at the end of the inlet pipe to protect the lagoon liner. If the lagoon is used for chlorine treatment, the outlet pipe is located as far as possible from the inlet pipe to increase chlorine detention time and to prevent *short-circuiting* (a condition where some of the wastewater in a lagoon travels faster than the rest of the wastewater, between the inlet and outlet pipes). Short-circuiting is especially a problem in lagoons that are designed to allow for a specific *chlorine contact time* (the amount of time chlorine must be allowed to react with the wastewater prior to discharge and reuse).

Other design considerations for storage lagoons include:

- Multiple cells to provide access for maintenance.
- Proximity to surface waters and well(s) used for drinking water.

- Locating lagoons to minimize odor impacts and consider the use of aeration to reduce odor causing conditions.

6.3.2.2 *Determining Lagoon Storage Needs*

The following are some of the some factors used to determine the volume of lagoon storage capacity that may be needed:

1. The local climate and the period of operation.
2. If the land application system is designed for growing season only application, the lagoon(s) may be designed for storage of effluent during the non-growing season.
3. If the land application system is designed with a non-growing season application allowance, storage may be necessary:
    - for periods of extreme cold temperatures which can prevent application due to freezing problems in the irrigation system, frozen soils, or buildup of ice on the application site, or
    - to limit wastewater application to ‘soil storage’ rates (see Sections 4.1.2 and 4.4.9 for further discussion of non-growing season hydraulic loading guidance).
4. If land application is not possible due to harvesting or heavy precipitation events.
5. Analysis of rainfall data also helps identify the storage needs related to expected periods of excessive precipitation. Some storage may be necessary to retain certain storm events on the land treatment site to prevent runoff. (See further discussion of runoff control in Section 4.1.3.)

6.3.3 Lagoon Seepage

It is important for lagoons to be sufficiently sealed, so that they do not become major contributors to the contamination of ground water. For this reason, reuse facilities may be required to demonstrate the integrity of their wastewater treatment and storage structures.

The following Web site provides guidance on methods to determine seepage rates:

http://www.deq.idaho.gov/water/assist_business/engineers/guidance/lagoon_seepage.pdf

Rules for seepage allowances for performance of new and existing municipal lagoons are found in Idaho’s *Wastewater Rules* (IDAPA 58.01.16.493.03a) and are discussed in Section 6.3.3.1.

6.3.3.1 *Seepage Requirements*

Performance criteria in DEQ rules require that municipal lagoons with construction ending after April 15, 2007 be allowed to seep at a rate of not more than 3,400 gallons/acre-day (0.125 inches/day). For municipal lagoons with construction ending prior to April 15, 2007, the rules allow for a seepage rate of not more than 6,800 gallons/acre-day (0.25 inches/day) (IDAPA 58.01.16.493.03b). Seepage testing for municipal lagoons is required every five years. See IDAPA 58.01.16.493.02 for further details. It is recommended that these seepage criteria be utilized for industrial lagoons as well.

6.3.3.2 *Submittal of Seepage Data*

DEQ typically recommends that recent industrial lagoon seepage data be submitted as part of the permit renewal application package every five years. This submittal is required for municipal lagoons (IDAPA 58.01.16.493.02). Results of the seepage data will determine any permit conditions needed to update or modify existing lagoons.

6.3.3.3 *Options for Addressing Excessive Seepage*

If a properly tested municipal lagoon leaks more than the allowable rate, the options for mitigation include the following:

1. Retesting the seepage rate immediately to determine the validity of the results of the initial test.
2. Repairing or replacing the lagoon (or installing a liner) and retesting.
3. Draining the lagoon in an approved manner (IDAPA 58.01.16.493.10) and discontinuing the use of the lagoon.
4. Developing a plan, based on ground water sampling and analyses, to determine the effect of the leakage on the local groundwater. If the effect of the seepage does not comply with the requirements of the *Ground Water Quality Rule* (IDAPA 58.01.11), then option 1, 2 or 3 must be used. See IDAPA 58.01.16.493.04a, b, c, and d. It is recommended that this four-step procedure be followed for industrial lagoons as well.

6.3.4 Lagoon Operation and Maintenance

Regardless of how well-designed, lagoons will not perform to their optimum potential unless properly operated and maintained. Inspections and sampling should be conducted on a routine basis to determine if any problems are apparent. Routine operation and maintenance practices should address and control the following conditions and situations:

- vegetation
- erosion
- odor production
- freeboard
- short-circuiting (if chlorine treatment is a component of the storage lagoon)

In addition, safety precautions such as posting and maintaining warning signs around a wastewater storage lagoon, can improve site safety and minimize public health impacts. Fencing should be provided to discourage unauthorized access and prevent wildlife access. See EPA (1977) and Kerri (1990, Chapter 9) for further information on topics discussed in Section 6.3.4.

6.3.4.1 *Vegetation*

Controlling vegetation around storage lagoons is important. Weeds and grasses on dams and dikes provide sheltered areas for insects and burrowing animals, interfere with the establishment and maintenance of a desirable vegetative cover, and hinder visual inspection of dikes. Trees and other deep-rooting vegetation can impair the structural integrity of lagoon dikes. Regular mowing and weeding are required to avoid these problems.

Emergent and suspended vegetation in lagoons take up valuable space, provide a breeding ground for potential vectors, such as mosquitoes, and hinder pond circulation. In addition, dead vegetation can contribute to BOD levels and cause odors.

6.3.4.1.1 *Emergent Vegetation*

Emergent growth will occur when sunlight is able to reach the lagoon bottom in older lagoons with earthen bottoms or lagoons with a buried synthetic liner. Emergent growth can be controlled by the following:

- immediate removal of young plants (including roots),
- drowning weeds by raising the water level and preventing sunlight from reaching the plants,
- by installing pond liners, and
- using herbicides according to label instructions and applicable state and federal laws, in addition to taking into consideration potential impacts to the land treatment system.

6.3.4.1.2 *Suspended Vegetation*

Suspended vegetation, such as duckweed and algae, can occur in any lagoon, regardless of depth. Often mistaken for algae, duckweed floats on a lagoon surface and has long hair-like roots that hang down into the water. It grows rapidly and can cover the entire surface of a lagoon if not controlled. If suspended vegetation is a problem, it should be skimmed off with rakes or other tools or mechanically harvested. Herbicides can be used according to precautions discussed in Section 6.3.4.1.1. If not removed, vegetation may cause plugging in the irrigation system.

Ducks eat duckweed and may control a light growth of suspended vegetation. Fecal waste from ducks and other waterfowl, however, can contribute BOD to the lagoon and increase coliform levels. Depending on the required disinfection level of the effluent, the point of compliance location in the treatment system, and microbial risk assessment, the attraction of waterfowl to a storage lagoon may seriously impact the effluent quality. Disinfection downstream of the storage pond may be necessary in some cases to achieve required effluent quality levels.

6.3.4.1.3 *Algae*

Excessive algae growth can create serious problems. Algae blooms die off as suddenly as they appear, blocking sunlight and the dead vegetation can cause foul odors. The die-off of algae blooms also causes a very high BOD loading which reduces dissolved oxygen levels, and the lagoon may become anaerobic or septic and cause odor problems.

Blue-Green Algae

A specific type of algae that can be problematic is blue-green algae (Cyanobacteria). A bloom (rapid growth) of blue-green algae can be caused by organic overloading, nutrient overloading, high water temperatures, or stagnant conditions.

Blue-green algae are bacteria that grow in fresh water lakes, ponds and wetlands, as well as wastewater storage lagoons. They are photosynthetic bacteria, and usually occur only in small numbers. They are so small they are invisible to the casual observer.

When a bloom occurs, huge numbers of algae grow and accumulate on the surface of the lagoon, to the point where the surface of the water resembles thick "pea soup." often blue-green in color. Although these blooms occur naturally, water bodies which have been enriched with plant nutrients from municipal, industrial or agricultural sources are particularly susceptible to these growths.

Blue green algae blooms are unsightly, but more important, blue-green algal blooms can be toxic if ingested by wildlife, livestock, or people. Blue green algae produce neurotoxins, which affect the nervous and respiratory systems and hepato-toxins, which affect the liver function.

If blue-green algal blooms are suspected, they should be treated with caution. One of the first signs of toxin contamination in a water body is the presence of stressed, sick or dead wildlife or waterfowl. Contact DEQ or your local District Health Department if you suspect a problem. Water suspected of being contaminated with toxic strains of blue-green algae can be sampled and tested for toxicity.

Algae Control

Algae mats should be broken up and dispersed or physically removed like duckweed. Algae can also be controlled by physical, chemical, and biological means:

- Lagoon covers (artificial or natural) eliminate sunlight, photosynthesis, and vegetative growth.
- Aeration or mixing removes carbon dioxide from the water and reduces plant growth.
- Shock chlorination at high doses for short duration and at a lower chlorine dose for longer duration have both been used successfully in controlling algae.
- Copper sulfate is the most common chemical used to control algae.
- Non-toxic dyes can be used to reduce sunlight penetration in the water.

When considering any chemical or biological means of algae control, an operator must make sure that the action is approved by the Idaho Department of Environmental Quality (DEQ) and is not a violation of permit conditions.

6.3.4.2 *Erosion*

Erosion can wash away clay liner material on inside banks or create cracks and crevices in outer banks. Both situations reduce the structural integrity of lagoon dikes and can result in leaks and dike failure. Erosion can be caused by wave action, surface runoff from precipitation, holes dug by burrowing animals, lack of proper vegetation on outside slopes, steep slopes, or poor maintenance.

Installing riprap or broken concrete along banks and dikes can minimize erosion and limit weed growth. However, this practice cannot be used for exposed synthetic liners.

Diversion ditches and proper grading around the lagoon may be used to divert surface water away from the lagoon. Burrowing animals, such as gophers, moles, ground squirrels, and groundhogs, should be trapped and removed. Burrowed holes should be repaired immediately to prevent erosion.

6.3.4.3 *Odor Prevention*

Some storage lagoons can produce odors from time to time, depending on the water quality of the stored wastewater and how the ponds are maintained and operated. If odors are a problem or anticipated to be a problem, an odor management plan should be submitted to and approved by DEQ.

The Odor Management Plan should cover wastewater treatment systems, land application facilities, storage lagoons, and other operations associated with the facility. The plan should include specific design considerations, operation and maintenance procedures, and management practices to be employed to minimize the potential for or limit odors. The plan should also include procedures to respond to an odor incident if one occurs.

Odors related to storage lagoons may be caused by the following:

- Storage of wastewater with a high organic content
- Stagnant conditions or long detention times of water in storage
- Lagoon turnover due to seasonal temperature changes. This causes a vertical movement of the lagoon contents causing the lower anaerobic zone to move towards the surface
- Accumulation of dead vegetation or algae in the lagoon

Most odors in the lagoon water column are caused due to anaerobic conditions which generate odorous gases such as hydrogen sulfide and mercaptans. See Section 2.3.2 for further discussion of nuisance conditions.

6.3.4.4 *Freeboard*

A properly designed storage lagoon system will provide adequate freeboard or safety volume to prevent an overflow from the lagoon. Unauthorized overflow from lagoons is a violation of state rules (see IDAPA 58.01.16.600.02 and IDAPA 58.01.17.500.03) and is subject to enforcement action. Allowing a lagoon to reach its maximum storage capacity before the start of the non-growing season does not leave room for storing excess precipitation during extended wet periods. In the late summer/early fall, lagoons should be pumped down as necessary to accommodate non-growing season flows, precipitation, etc.

In Idaho, storage lagoons are designed to have a minimum of two feet of permanent freeboard. Under normal operations, the freeboard space will not be used for water storage. However, under some conditions, the freeboard space may be encroached upon:

- Extremely high precipitation event.
- High wastewater generation rates due to rapid population growth, inflow/ infiltration problems or, in industrial systems, plant upsets or unusual operations resulting in greater generation of wastewater.
- Inability to lower storage lagoon volume to minimum levels prior to the winter storage season.

If a situation arises that could result in approaching a lagoon overflow, contact your regional DEQ office to evaluate the situation and to determine what actions and approvals may be needed.

6.3.4.5 *Short-Circuiting*

Short-circuiting is a condition that occurs when some of the wastewater in a lagoon or basin travels faster than the rest of the flowing water, typically between the inlet and outlet pipes. This problem can be caused by such factors as poor design, sludge accumulation in the lagoon bottom, vegetation that hinders lagoon circulation, and temperature gradients in the water column.

Short circuiting is a concern for lagoons that perform treatment or are used for chlorine disinfection. It is less of a concern for lagoons used solely for storage. Short circuiting may cause stagnant conditions in a portion of the lagoon, which result in odor problems depending on the wastewater quality. Short-circuiting can be verified by the use of dye tests and may be corrected or prevented by using curtains or baffles to redirect flow, relocating inlet and outlet pipes, controlling vegetation, and removing excessive sludge deposits from the lagoon.

6.4 Grazing Management

Although well managed livestock grazing is an effective method for harvesting crops grown on wastewater land treatment sites, poorly managed livestock grazing can result in negative environmental impacts and pathogen transmission to grazing animals when land applying municipal wastewater.

This section discusses livestock grazing on wastewater land treatment sites; avoiding adverse grazing impacts; grazing plans; general, growing and non-growing season grazing conditions; and special considerations regarding grazing on municipal land treatment sites.

6.4.1 Avoiding Adverse Impacts from Grazing

Adverse impacts to the site and the environment caused by livestock grazing can be avoided through careful consideration of nutrient balance and additional nutrient loading rates from livestock manure, compaction of the soil, and the effects of overgrazing.

6.4.1.1 *Calculating Nutrient Loading Rates with Grazing*

Nutrient loading rates should be calculated as described in Sections 4.2.2, including the additional input from manure deposited by grazing animals and the mineralization (nutrient release) rate over time of the manure being considered. Further information regarding these calculations can be found in UDSA (1992), Araji and Abdo (No Date), Cogger and Sullivan (1999), and Beegle (1997).

6.4.1.2 *Avoiding Soil Compaction*

If animals are allowed on a land treatment site when soils are wet, substantial soil compaction can occur, leading to decreased infiltration rates, a subsequent increase in the potential for runoff, and reduced plant growth. This problem can be avoided by grazing only when soils are adequately drained and soil moisture is below *field capacity*, a measure of moisture percentage after rapid drainage. (See further discussion of soil moisture determination in Section 6.4.2.1 and discussion of field capacity in Sections 2.3, 4.4.7, and 7.7.7.)

6.4.1.3 *Avoiding Over-Grazing*

Over-grazing of a site can decrease plant growth and vigor, leading to reduced water and nutrient uptake and increasing the potential for deep percolation and contamination of ground water. Moreover, reduced plant vigor causes long-term reduction in yields and the capacity of the site to support grazing.

Over-grazing can be avoided by limiting the number of animals, limiting the time that animals remain on the field or plot, rotating livestock from plot-to-plot based on the amount of remaining vegetation, and adhering to an approved grazing management plan.

6.4.2 Grazing Management Plan

To ensure that crop health and soil properties remain effective for wastewater land treatment, a grazing management plan is necessary for both the growing and non-growing seasons. Grazing plans must be reviewed and approved by DEQ before being implemented.

The grazing plan should follow the guidance and specifications of relevant sections of the USDA Natural Resource Conservation Service (NRCS) *Field Office Technical Guidance* (FOTG), which can be accessed electronically from the following Web site:

http://www.nrcs.usda.gov/technical/efotg

Table 6-1 lists available guidance from NRCS related to grazing management.

Table 6-1. Relevant NRCS grazing guidance and specifications.

Practice Name	Code	Where Applicable
Pasture and Hayland Planting	512	Pasture, hayland, or land converted from other uses
Grazing Land Mechanical Treatment	548	Native grazing land

See also the NRCS *National Range and Pasture Handbook,* which can be accessed at the following Web site:

http://www.glti.nrcs.usda.gov/technical/publications/nrph.html

Of particular interest in this publication is Chapter 5, 'Management of Grazing Lands.'

6.4.2.1 *Conditions for All Wastewater Land Treatment Site Grazing*

All wastewater land treatment site grazing is subject to the following conditions:

- Livestock should be on site only until feed is depleted. Minimum leaf length and stubble height before and during grazing should be observed (Table 6-2).
- There should be no irrigation while livestock are on site.
- Livestock should be removed if precipitation wets soil such that soil/crop damage may result.
- A written statement from the permittee to DEQ, stating that the permittee has control over the management of the grazing animals, is needed.
- There should be no supplemental feeding of livestock while on the wastewater land treatment site.

Table 6-2. Minimum leaf lengths and stubble heights recommended for grazing (SCS, 1986).

Column A	Column B	Column C1
Plant Species - Common Name	Minimum Leaf Length Reached Prior To Initiating Grazing (in.)	Minimum Stubble Height to Remain Following Grazing Or Hay Harvesting (in.)
Kentucky bluegrass	6	3
Smooth bromegrass	8	4
Regar bromegrass	8	4
Reed canarygrass	10	6
Tall fescue	8	4
Orchardgrass	8	4
Timothy	8	4
Garrison creeping foxtail	10	4
Tall wheatgrass	10	8
Intermediate wheatgrass	10	4
Pubescent wheatgrass	8	4
Siberian wheatgrass	6	3
Crested wheatgrass	6	3
Russian wild rye	8	4
Alfalfa	14	3
Ladino clover	8	3
Red clover	6	3
Alsike clover	6	3
Sweet clover	8	4
Trefoil	8	3
Sainfoin	12	6
Milkvetch	8	4
White dutch clover	4	2

1 This is the minimum stubble height to be remaining at end of grazing period or hay harvest operation. When a grass-legume mixture is harvested for hay, generally use most limiting stubble height for the mixture.

In the event there is a significant precipitation event, causing standing water or muddy conditions while livestock are on the site, the livestock should be removed. A determination of soil moisture should then be made to assess whether crop damage and/or soil compaction will result from continued grazing. The surface soil layer can be sampled after the precipitation event and evaluated for soil moisture according to Table 6-3 and the "feel method". This involves collecting surface soil samples at several places in the field. The soil water status for each sample is estimated by feeling the soil to determine whether soils are like those in the shaded boxes in Table 6-3 (Wright and Bergsrud, 1991)**.** If so, soil conditions may be too wet for grazing.

Table 6-3. Guide determining soil moisture. (Source: Ashley et al., 1997)
Note: Numbers in cells to the right of the first column indicate inches of water deficit per one foot of soil.

Soil-Moisture deficiency	Coarse Texture (loamy sand)	Moderately Coarse Texture (sandy loam)	Medium Texture (loam)	Fine and Very Fine Texture (clay loam)
0% (Field capacity)	Upon squeezing, no free water appears on soil but wet outline of ball is left on hand. (0.0)	Upon squeezing, no free water appears on soil but wet outline of ball is left on hand. (0.0)	Upon squeezing, no free water appears on soil but wet outline of ball is left on hand. (0.0)	Upon squeezing, no free water appears on soil but wet outline of ball is left on hand. (0.0)
0 - 25%	Tends to stick together slightly, sometimes forms a very weak ball under pressure. (0.0 to 0.2)	Forms weak ball, breaks easily, will not slick. (0.0 to 0.4)	Forms a ball, is very pliable, slicks readily if relatively high in clay. (0.0 to 0.5)	Easily ribbons out between fingers, has slick feeling. (0.0 to 0.6)
25 - 50 %	Appears to be dry, will not form a ball with pressure. (0.2 to 0.5)	Tends to ball under pressure but seldom holds together. (0.4 to 0.8)	Forms a ball somewhat plastic, will sometimes slick slightly with pressure. (0.5 to 1.0)	Forms a ball, ribbons out between thumb and forefinger. (0.6 to 1.2)
50 - 75%	Appears to be dry, will not form a ball with pressure. |(0.5 to 0.8)	Appears to be dry, will not form a ball. (0.8 to 1.2)	Somewhat crumbly but holds together from pressure. (1.0 to 1.5)	Somewhat pliable, will ball under pressure. (1.2 to 1.9)
75 - 100% (100% is permanent wilt point)	Dry, loose, single-grained, flows through fingers. (0.8 to 1.0)	Dry, loose, flows through fingers. (1.2 to 1.5)	Powdery, dry, sometimes slightly crusted but easily broken down into powdery condition. (1.5 to 2.0)	Hard, baked, cracked, sometimes has loose crumbs on surface. (1.9 to 2.5)

Soils having moisture characteristics described in the shade portions of Table 6-3 should be allowed to drain to a suitable soil moisture content prior to grazing. General drainage times, in days, are provided in Table 6-4.

Table 6-4. Generalized drainage times for uniform soil profiles of varying textures.

Texture	Drainage Time (Range in days)
Loamy Sand	0.5 – 2
Sandy Loam	3 – 4
Silt Loam	4 – 6
Clay Loam	5 – 7

Source: Carlisle and Phillips, 1976; Donahue et al., 1977.

6.4.2.2 *Conditions for Growing Season Grazing*

When developing a grazing management plan specifically for the growing season, the following items should be included:

- Type and number of animals to be grazed on the site.
- Identification of times when animals can be put on a plot and when they should be removed, based on plant growth characteristics (plant height or other criteria). Indicate the primary growing season or months anticipated for the grazing season.
- A schedule for rotating the animals through the site. Include a map showing plot arrangement, location of salt blocks, protein blocks, and water. The grazing

management plan should include a schedule for rotating the location of any salt or protein blocks to prevent excessive traffic on any portion of the site.

- A nutrient balance, accounting for crops grown, crop yield, fertilizers used, and nutrients removed and added by livestock. (See further discussion in Sections 4.2.2.3, 4.2.2.4, and 6.4.1.1)

6.4.2.3 *Conditions for Fall "Clean-Up" (Non-Growing Season)*

There can be appreciable vegetative material left after harvest on fields, as well as along fence rows and ditch banks. Feed value of this post-harvest material often can be utilized by grazing animals. If a wastewater land treatment site is to be grazed solely for the purpose of fall "clean-up" of the site, then the following conditions should be met:

- Livestock should be on site only after harvest.
- Livestock should be off site no later than December 31st.
- No winter pasturing of livestock or supplemental feeding.

6.4.3 Grazing on Land Application Sites Irrigated with Treated Municipal Wastewater

This section establishes program guidance on the practice of using treated municipal wastewater to irrigate sites grazed by animals used for dairy or meat production. The Idaho State Department of Agriculture (ISDA) and the Idaho Division of Environmental Quality (DEQ) jointly developed this guidance.

In February 1990, DEQ established program guidance disallowing grazing on all land application sites using treated municipal wastewater. The primary reasons cited for this decision were 1) the potential public health risks and 2) the limited resources of the agency to reasonably insure compliance with grazing management plans.

However, with subsequent EPA guidance (1992)—as well as regulations developed by neighboring states—indicating that grazing is acceptable under certain conditions, DEQ drafted a recommendation for grazing municipal sites and sought comments from ISDA and the District Health Departments. ISDA and DEQ formed a working committee to revise the draft guidance to address potential health risks to both humans and grazing animals. Table 6-5 presents the mutual recommendation of ISDA and DEQ, with the exception of an increase in waiting time for Class B wastewater to a 3 day minimum.

Table 6-5. Permissibility of grazing on municipal wastewater land applications sites.

Wastewater Class	Grazing	Approved Grazing Plan[1]	Minimum Waiting Period prior to Grazing after Wastewater Application (to allow for soil drainage and pathogen die-off[2]	Applicability of Odor Provisions[3]
B	Allowed	Required	3 to 7 days[4]	Applicable
C	Allowed	Required	15 to 30 days	Applicable
D	Not Allowed (IDAPA 58.01.17.600.07d)	NA	NA	NA
E	Not Allowed (IDAPA 58.01.17.600.07e)	NA	NA	NA

Notes:
1) See Section 6.4.2 for information on grazing management plans.
2) See Table 6-4 for generalized soil drainage times.
3) See Section 2.4.2 for further discussion of odor and other nuisance conditions.
4) EPA 2006, Section 4.4.2.

6.5 Buffer Zones

Buffer zones provide distance between the boundary where wastewater-land application ceases and the following:

- Dwellings
- Public or private water supplies
- Surface water
- Areas of public access

Buffer distances are established to protect 1) the public from exposure to land applied wastewater, and 2) drinking water supplies and surface water.

This section presents general buffer zone guidance, and more specific guidance applicable to municipal and industrial wastewater land treatment facilities. Also presented are criteria for alternative industrial wastewater buffer zone distances.

6.5.1 General Buffer Zone Distances

The following general recommendations for buffer zones (DEQ, 1988) should be considered to protect against the potential for aesthetic and public health impacts:

- A land treatment system should not be located closer than 300 feet from the nearest inhabited dwelling.
- A land treatment system should not be located closer than 1,000 feet from a public water supply well or 500 feet from a private water supply well used for

human consumption. (See further discussion of buffer zones from wastewater land treatment facilities to wells in Section 6.6.4.1.)

- A minimum buffer of 50 feet should be provided between the wastewater application site and areas accessible by the public.
- The distance from the treatment site to permanent or intermittent surface water, other than irrigation ditches and canals, should be 100 feet.
- A 50-foot separation distance should be provided between the land treatment site and temporary surface water and irrigation ditches and canals.

6.5.2 Facility-Specific Buffer Zone Distances

General buffer zone distances listed in Section 6.5.1 may not be suitable in certain site-specific circumstances. Facility-specific considerations often may need to be considered. Recommended buffer zone distances, and signing, and posting guidance for both municipal and industrial wastewater land treatment sites, is provided in the following sections.

6.5.2.1 *Municipal Wastewater Buffer Zones*

Table 6-6 presents specific buffer zone guidance for municipal wastewater. Sixteen different scenarios are presented for existing and new land application systems. To use the table, read vertically, to find applicable site or facility conditions and associated buffer zone, fencing, and posting recommendations.

For example, Scenario D uses municipal wastewater with effluent of advanced secondary quality. The wastewater land treatment site is in a residential area, and the wastewater is sprinkle irrigated.

Continuing down the column, buffer zone distances, signing, and posting requirements are given. Note that Class A wastewater is not included in Table 6-6, as there are no buffer zones required with this wastewater class.

Table 6-6. Buffer Zone Guidance for Municipal Wastewater Treatment Sites

Site Condition	Scenarios															
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**
Wastewater Class and Degree of Treatment																
Class E: Primary, not disinfected, with organisms too numerous to count (TNTC) (1)	X				X				X				X			
Class D: Primary Disinfected to < 230 CFU/100 ml (1)		X				X				X				X		
Class C: Secondary Disinfected to <23 CFU/100 ml (1)			X				X				X				X	
Class B: Advanced Secondary Disinfected to <2.2 CFUg/100 ml (1)				X				X				X				X
Location																
Suburban or Residential Area	X	X	X	X					X	X	X	X				
Rural or Industrial Area					X	X	X	X					X	X	X	X
Mode of Irrigation																
Sprinkler Irrigated	X	X	X	X	X	X	X	X								
Furrow/Flood Irrigated									X	X	X	X	X	X	X	X
Resulting Buffer Zone Recommendations																
Buffer Zone Between:																
Site and Inhabited Dwellings (in feet)	1000	500	300	100	1000	500	300	100	300	300	50	50	300	300	50	50
Site and Areas																
Accessible to Public (in feet)	1000	300	50	0	1000	300	0	0	100	100	0	0	50	50	0	0
Fencing Type																
Cyclone w/Barbed Wire									X	X						
Woven Pasture Fence	X	X	X		X						X		X	X		
Three-Wire Pasture Fence						X	X									
None Required				X				X				X			X	X
Posting Recommendations																
Required (2)	X				X				X				X			
Required (3)		X	X	X		X	X	X		X	X	X		X	X	X

(1) Organisms here are total coliform in concentrations of colony forming units per 100 milliliter (CFU/100 mL). Bacteria count represents the total coliform bacteria as a median of the last 7 days of bacteriological sampling for which analysis have been completed

(2) Signs should read 'Sewage Effluent Application - Keep Out' or equivalent to be posted every 250 feet and at each corner of the outer perimeter of the buffer zone(s) of the site

(3) Signs should read 'Irrigated with Reclaimed Wastewater - Do Not Drink' or equivalent to be posted every 500 feet and at each corner of the outer perimeter of the buffer zone(s) of the site

6.5.2.2 *Industrial Wastewater Buffer Zones*

To protect public health and prevent aesthetic impacts or public nuisance conditions, buffer zones for industrial wastewater apply to both existing land application systems and to all new systems. Table 6-7 provides recommended buffer zone distances for industrial wastewater(s). To use the table, read vertically, to find applicable site or facility conditions and associated buffer zone, fencing, and posting recommendations.

Table 6-7. Buffer Zone Guidance for Industrial Wastewater Treatment Sites.

SITE CONDITIONS FOR INDUSTRIAL WASTEWATER LAND TREATMENT SITES	SCENARIOS			
	A	**B**	**C**	**D**
LOCATION				
Suburban or Residential Area	X	X		
Rural or Industrial Area			X	X
MODE OF IRRIGATION				
Sprinkler Irrigated	X		X	
Furrow Irrigated		X		X
RESULTING BUFFER ZONE REQUIREMENTS:				
BUFFER ZONE BETWEEN:				
Site and Dwellings (feet)	300	200	300	200
Site and Areas access. to Public (feet)	50	50	50	0
FENCING TYPE				
Three-Wire Pasture Fence	X	X		
Not Required			X	X
POSTING				
Required[1]	X	X		
Not Required			X	X

(1) Signs should read 'Irrigated with Reclaimed Wastewater - Do Not Drink,' or equivalent, and should be posted every 500 feet and at each corner of the outer perimeter of the buffer zone(s) of the site.

Greater buffer zone distances may be necessary if the wastewater is of similar quality as raw or primary sewage or has particular industrial contaminants that warrant a more protective buffer zone.

In instances where recommended buffer zones may be either overly protective or insufficient for a particular facility or site, the criteria in Section 6.5.3 should be used to determine proposed alternate buffer zone distances. However, applicants must provide adequate justification of alternative buffer zones as part of the system design.

All buffer zones must comply with local zoning ordinances.

6.5.3 Criteria for Alternative Wastewater Buffer Zones

If a recommended buffer zone is considered unreasonable or unnecessary for a specific site, it is incumbent upon the permittee to propose an alternative distance and justify this proposal to DEQ. The alternative distance proposal should be specific to a given site and should demonstrate how public health and the waters of the state will be adequately protected.

The following approaches to minimizing wastewater spray drift and/or degree of exposure should be considered when proposing alternative buffer zones:

- Conduct a microbial risk analysis, which involves characterizing the type and concentration of pathogens in the wastewater under typical operating conditions, their dispersion in air, and their risk to human receptors. (See further discussion in Section 3.4.9.3.)
- Provide a higher degree of pretreatment, such as oxidation, anaerobic treatment, disinfection, or filtration for the removal of wastewater pathogens, prior to applying to land surface.
- Use alternative methods of irrigation, such as low pressure sprinkler irrigation, to reduce spray or airborne exposure from *drift*[1].
- Provide a physical or vegetative barrier designed to reduce drift or *aerosol*[2] dispersion. Appropriately designed vegetative barriers can provide adequate buffer capability for wastewater land treatment sites. See Spendlove, et al., (1980), for one example of how to design vegetative barriers.
- Monitor the wind speed and direction on a real-time and site-specific basis to determine timing of irrigation events.

6.6 Protection of Domestic and Public Well Water Supplies

This section discusses regulatory programs, including federal law and Idaho rules that protect drinking water supplies and drinking water wells near wastewater land treatment facilities.

6.6.1 Source Water Protection and the Safe Drinking Water Act

The amendments to the *Safe Drinking Water Act* (SDWA) of 1986 authorized the *Wellhead Protection Program* for states to develop and implement for protection of ground water and drinking water supply systems. The Act was further enhanced in 1996 with the passage of additional amendments requiring states to develop source water assessment plans for all public water supplies.

[1] Drift is typically considered to be those droplets greater than 200 microns in size and aerosol is generally considered to be droplets less than 200 microns in size (Kincaid, 1995, ARS, Kimberly, Idaho.)

[2] Aerosols refer to fine spray droplets containing wastewater microorganisms that have evaporated to dryness or near dryness, leaving a much smaller solid or semi-solid particle or bio-aerosol that can travel much farther than the original droplet.

The 1996 amendments also included preventative protection measures for public surface water supplies, in addition to the ground water supplies addressed under the previous Wellhead Protection Program.

Implementing a local *Source Water Protection Program* is encouraged, but is not mandatory.

6.6.2 Source Water Protection under Idaho Rules

Idaho's Source Water Protection Program uses a voluntary approach intended to supplement the *Idaho Rules for Public Drinking Water Systems* (IDAPA 58.01.08). Although Idaho is required, under the Safe Drinking Water Act Amendments of 1996, to assess every source of public drinking water for its sensitivity to contaminants regulated by the Act, communities can utilize information provided in the Source Water Assessments to develop *source water protection areas* to suit local conditions.

6.6.2.1 *DEQ Provides Technical Assistance and Guidance*

DEQ is designated to provide technical assistance and guidance on the Source Water Protection Program to local governments and water system purveyors. DEQ has developed information on wellhead protection (Wellhead Protection Plan, DEQ 1997) and source water protection (Protection of Drinking Water Sources in Idaho, DEQ 1999) to address the protection of drinking water supplies in Idaho.

6.6.2.2 *Local Requirements May Be More Stringent Than State Rules*

It is the responsibility of the Reuse permittee or applicant to inquire of appropriate planning and zoning jurisdictions and local governing bodies as to whether their site is within a source water protection area. Because each community can choose to develop its own Source Water Protection Plan as additional protection beyond the requirements of IDAPA 58.01.08, it is recommended that a wastewater reuse permittee contact the local city/county government or water purveyor about established or developing local source water protection programs or ordinances.

Local ordinances and planning and zoning requirements are to be followed and, where stricter than state regulations, used in the design of the facility and in the siting of wells and treatment sites.

6.6.2.3 *Special Conditions for Sensitive Resource Aquifers*

Refer to Sections 12.8 and Appendix A.13 for special considerations on source water protection areas and wastewater land treatment systems overlying the Rathdrum Prairie Aquifer.

6.6.3 Protection of Domestic Water Supplies

A permit to construct a well is required by the *Well Construction Standards Rules* (IDAPA 37.03.09) administered by the Idaho Department of Water Resources. This permit applies to all water wells, including domestic wells (individual, public, and non-public wells), irrigation wells, monitoring wells, and low temperature geothermal wells. The same permitting requirements apply to wells drilled to augment or replace existing wells.

Placement of wells in relation to potential sources of contamination, such as wastewater-land application systems, is addressed by DEQ or the District Health Department, depending on the source of contamination and/or the land use activity.

DEQ is responsible for regulating, in accordance with the Safe Drinking Water Act Program in Idaho, the water quality standards for all public water systems. Inspections and technical assistance services are provided to public water systems by both the DEQ and/or the District Health Departments, depending on the number of connections and source of supply. (For further information, see Idaho Statutes Title 39, Chapter 1.)

Generally, DEQ provides assistance to all surface water systems and public water systems with more than 25 connections. The Health Districts assist smaller public water systems (10 to 25 connections), individual domestic well owners, and commercial systems on individual wells (DEQ, 2000).

6.6.4 Protection of Well Water Supplies near Wastewater Land Treatment Facilities

The buffer zones recommended in Section 6.5.1 (500 feet between domestic wells and a wastewater land treatment site and 1000 feet between a site and a municipal water supply well) are general recommendations and may not be appropriate in all circumstances. The number of domestic and municipal wells, the size of the facility, the local hydrogeology, and the extent of existing or potential contamination are just some of the factors that may indicate the need for a more thorough evaluation of the respective locations of wastewater land treatment sites and wells.

The discussion that follows presents an evaluation methodology called the *Well Location Acceptability Analysis* (WLAA). The WLAA considers the facility type, site constituent loading rate, well proximity to land treatment facilities, hydrogeological setting, and existing and predicted ground water quality, to determine suitability of respective locations of water supply wells and land treatment acreage.

Also discussed are descriptions of capture and mixing zone analyses and methods to conduct these analyses.

6.6.4.1 *Well Location Acceptability*

The decision flow chart shown in Figure 6-2 **Error! Reference source not found.** provides guidance on determining the acceptability or non-acceptability of domestic private, shared (non-public), or municipal (public) well locations, or other public water systems (PWS) with respect to wastewater land treatment sites:

- “Well/Site Location Acceptable” means the wastewater land treatment site is not likely to cause contamination of the aquifer, and the beneficial uses of the ground water pumped from the well should be maintained. However, the wastewater-land application permit may require monitoring of the well to substantiate that contamination is not occurring at present or likely to occur in the future.

- "Well/ Site Location Not Acceptable" means that the relative positions separating the proposed or existing wastewater land treatment site and an existing or planned well is unacceptable.

When conducting a well location acceptability analysis, it is important to recognize and account for all potential contaminant sources. There may be cases where there are causative factors of ground water contamination unrelated to land treatment activities. These must be considered when conducting the analysis and in making well/location acceptability determinations.

6.6.4.2 *Preliminary Questions: Minimum Distances and Hydraulically Separate Aquifers*

The first question in Figure 6-2 **Error! Reference source not found.**asks whether the well is closer than 1/4 mile from the site. This question establishes an initial universe of wells to consider the suitability of the wastewater-land application site in relationship to wells. If the well is not within 1/4 mile, it is generally not considered, but can be, depending on site-specific conditions.

The next question asks whether a well is closer than 50 feet, which is the distance required between a public water well and the property boundary on which it is located (Idaho Rules for Public Drinking Water Systems, IDAPA 58.01.08.510.02 and 512. If it is, the location is not acceptable. The same protection is provided for all domestic water systems whether an individual, non-public, or public water supply system.

If the well/site location is greater than 50 feet, the next question asked is whether the well is completed in a hydraulically isolated lower aquifer. If so, the well/site location is acceptable because any contamination from the land treatment site would be of the upper (water table) aquifer only. Determination of hydraulic isolation of a lower aquifer must take into account several factors:

- The well should be completed in a confined aquifer.
- The integrity of the confining layer(s) and vertical hydraulic gradient must be determined.
- The degree of leakage of the aquitard(s) may change during well pumping conditions and should also be considered.
- The adequacy of well construction (see IDAPA 39.03.09 and IDAPA 58.01.08.550.03b) to isolate a lower aquifer must be documented.

If hydraulic isolation can be demonstrated, then generally the well/location is acceptable. If not, the well is regarded to be in a shallow water table aquifer.

The next question asks whether the wastewater land treatment site is a 'municipal site', i.e. whether wastewater from a municipal sewage treatment plant or other sanitary source is applied. If no, this generally indicates little regulatory concern for microbial pathogens, and consideration of impacts from hydraulic, nutrient, and other constituent loading are considered. It is important to note that certain industrial wastewaters may have pathogenic microorganisms at levels of regulatory concern. If this may be the case, a 'yes' answer to the 'municipal site' question would be appropriate. See Section 3.4.9 for further discussion on pathogenic organisms in wastewater.

6.6.4.3 *Capture Zone Analyses*

If the site is not a municipal site, the next question asks whether the site intersects the capture zone of the well. This section discusses WLAA criteria for acceptability and capture zone analysis methodology.

6.6.4.3.1 *Capture Zone Analysis Criteria for Acceptability*

A Capture Zone Analysis (CZA) must be conducted. A capture zone (CZ), or *zone of contribution*, is defined as the area surrounding a pumping well that supplies ground water recharge to the well (EPA, 1991). (See further discussion in Section 6.6.3.)

The capture zone analysis determines if the boundaries of a wastewater-land application site or down-gradient off-site areas overlie the delineated zone from which the well draws water. CZ delineations can be calculated to reflect specific times of travel (TOT—always stated in *years* in this document) from the boundary of a delineation to the well, given specific aquifer and well characteristics, pumping rate etc.).

A CZ is calculated for an infinite time of travel (TOT = ∞) to determine the largest possible CZ and any likelihood of the CZ overlying boundaries mentioned above:

- If the infinite TOT CZ does not intersect land treatment boundaries or down gradient areas, it is unlikely that the well would be drawing water from a zone influenced by land treatment activities. The well/site location is acceptable.
- If the wastewater land treatment site lies within the CZ TOT = ∞, questions regarding ground water quality follow.

6.6.4.3.2 *Capture Zone Analysis Methodology*

A capture zone, or zone of contribution, is defined as the zone surrounding a pumping well that will supply ground water recharge to the well (EPA, 1991). Capture zone analyses are done to see whether the delineated zone where a well draws water overlies the boundaries of a wastewater-land treatment area. A well within these boundaries is subject to potential impacts from this land-use activity.

Methodologies for the delineation of capture zones are discussed in detail in EPA (1994), Chapter 4 'Simple Methods for Mapping Wellhead Protection Areas'. DEQ (1999), Chapter 4 also discusses types of ground water delineations including arbitrary-fixed radius, calculated-fixed radius, and refined analytical methods. Appendix E of DEQ (1999) provides technical guidance for their calculation. DEQ (1997), Chapter 4 discusses Idaho-specific capture zone delineation in detail, and Appendix F of that document provides further technical guidance for calculations and tables of aquifer properties necessary for calculations.

Several important model input sources are appended. Figure 2-1 in Section 2.1.4 shows locations and types of major aquifers in Idaho. Sections 2.5.3 through 2.5.8 contain general tables of aquifer properties, an extended table of transmissivities (and other data) for several wells in Idaho, a table of Idaho-specific hydraulic conductivities by rock type, a map of hydraulic conductivity zones, and hydraulic conductivities for typical aquifer materials. These sections provide general parameter values for input to the capture zone model mentioned above. See Section 2.1.4.2.2 for further discussion of these parameters. Each site should use values as site-specific as possible for input to the model.

EPA (1994) Chapter 6 discusses computer modeling for calculating delineations. DEQ (1999) Appendix E provides a less technical but more current computer modeling discussion including models currently recommended. The Wellhead Protection Area (WHPA) software has been used to define capture zones, which is a modular semi-analytical model developed by EPA (1991). This software, however, has been superseded by WhAEM 2000 (EPA, 2000).

6.6.4.4 *Analysis of Ground Water Quality Data*

The next question asks whether there is existing ground water quality data from the domestic or municipal well being evaluated, or from monitoring wells (surrogate(s) to the subject well) representative of the subject well.

These data must be of a certain quality to make well location acceptability decisions. Data must be sufficient to document that ground water quality of a site is *representative* of the loading and management of the site as currently permitted, or as proposed in a permit application. For data to be representative, the site must be at steady-state conditions, having been loaded and managed consistently for a period of time, so that ground water quality is reflecting whatever impacts, if any, the land treatment site may be causing to the subject well.

If the site has been operating for a time too short to establish steady state conditions, ground water data would not likely be representative. If the site is at steady state conditions, but proposed management and loading of the site are different than current operations, data would likely not be representative of anticipated operations.

Data may often reflect impacts from other land uses besides wastewater land treatment. Influences from feedlots, dairies, septic systems, and irrigated agriculture must be taken into account when utilizing water quality data from domestic and municipal wells. These influences may complicate the use of the data for WLAA purposes.

6.6.4.5 *Compliance with the Ground Water Quality Rule*

If there are ground water data available meeting the conditions discussed above, the next question is whether these data are in compliance with the Ground Water Quality Rule (GWQR, IDAPA 58.01.11).

This regulatory analysis, which involves the determination of degradation, significance of degradation, trends, and both of these characteristics in relation to ground water standards and other criteria, is beyond the scope of this guidance, but if the data are in compliance with the GWQR, the well/site location is acceptable. If not, the well/site location is not acceptable.

6.6.4.6 *Mixing Zone Analysis*

In the event ground water data meeting the conditions discussed above are not available, a mixing zone analysis (MZA) is conducted. This section discusses WLAA criteria for acceptability and mixing zone analysis methodology.

6.6.4.6.1 *Mixing Zone Analysis Criteria for Acceptability*

An MZA involves calculating hydraulic and constituent balances to determine percolate volume and constituent concentration.

Aquifer flow is also calculated, and both percolate and aquifer flow are mathematically mixed to obtain an estimate of the steady-state concentration of ground water discharging from the down gradient boundary of the land treatment site.

MZA methodologies can be found in EPA (1981) and EPA (1996). Further discussion of MZA methodology can be found in Sections 6.6.3 and 7.7.5.

The final question asks whether the predicted MZA impacts from the wastewater land treatment site are in compliance with the GWQR. If the predicted impacts are in compliance with the GWQR, the well/site location is acceptable. If not, the well/site location is not acceptable.

6.6.4.6.2 *Mixing Zone Analysis Methodology*

Mixing zone calculations provide rough estimates of potential ground water constituent concentrations resulting from the operation of a wastewater land treatment system: 1) after the system has reached steady state conditions; and 2) under ongoing consistent management of the system.

Mixing zone analysis (dilution analysis) equations used to predict steady state ground water quality are found in EPA (1981) Chapter 3, and EPA (1996) Chapter 2. These analyses provide a rough estimate of the potential of the site, as managed or as proposed to be managed, to impact ground water moving beneath the site. Methodologies are discussed in detail in Section 7.6.5.2.2. Sections 2.5.3 through 2.5.8 provide aquifer parameters for use in mixing zone calculations.

The user should be familiar with the assumptions of the model to be able to interpret the output. Calculation methodologies presented here yield rough estimates and typically do not take into account attenuation mechanisms which will certainly take place to varying degrees in the environment. Attenuation factors that may need to be considered include: decay and degradation; retardation; and adsorption, precipitation and other chemical reactions. Operation and management may need to be considered also. Modifications of methodologies and more sophisticated approaches may be necessary depending on site-specific circumstances.

Calculated steady-state down-gradient ground water concentrations (C_{mix}), should not exceed levels of regulatory concern as determined by DEQ (IDAPA 58.01.11).

6.6.4.7 *Municipal Site Well Acceptability*

Returning to the question as to whether the site is a ‘municipal site’, questions regarding wastewater class and distances follow. If the well is not greater than or equal to 100 feet from the site, the well/site location is not acceptable. This distance is derived from distances from a PWS or domestic water supply and various sanitary sources such as septic tanks, drainfields, seepage pits etc. See further IDAPA 58.01.08.900.01 and 58.01.03.007.17, 008.02d.

If the distance is greater than 100 feet, and the wastewater applied is Class B (see IDAPA 58.01.17.600.07b), regulatory concerns for pathogen attenuation and distances are satisfied and concerns regarding hydraulic, nutrient, and other constituent loading can be addressed as with non-municipal wastewaters.

If the wastewater applied is not Class B, but Class C (see IDAPA 58.01.17.600.07c), and the well is greater than 300 feet from the site, regulatory concerns for pathogen attenuation and distances are satisfied and concerns regarding hydraulic, nutrient, and other constituent loading can be addressed as with non-municipal wastewaters. This distance is derived from the largest distance specified in IDAPA 58.01.03.013.04d for large soil sorption systems and all domestic wells.

If the 300 foot distance cannot be met, or wastewater is not Class B or C (i.e. meaning high pathogen count Class D or E wastewaters being applied), a one-year capture zone (CZ TOT = 1) must be met. This distance is derived from the protective minimum for attenuation of pathogens potentially introduced into the aquifer through aquifer recharge (DEQ, 2006, page 12):

- If the well is not within the one-year CZ, the well likely has sufficient pathogen attenuation time, and questions regarding ground water quality follow.
- If it is within the one-year CZ, the well is not deemed to have sufficient pathogen attenuation time, and a Vadose Zone Time of Travel Analysis (VZTTA) analysis is indicated. See Section 7.7.5.2.3 for VZTTA methodologies.

6.6.4.8 *Vadose Zone Travel Time*

The next question asks whether the total time of travel summing both aquifer and vadose zone time of travel (VZ TOT) is less than one year. If it is, the well is not deemed to have sufficient pathogen attenuation time, and the well/site location is not acceptable.

If the sum of the CZ and VZ TOT is one year or greater, regulatory concerns for pathogen attenuation and distances are satisfied and concerns regarding hydraulic, nutrient, and other constituent loading can be addressed as with non-municipal wastewaters.

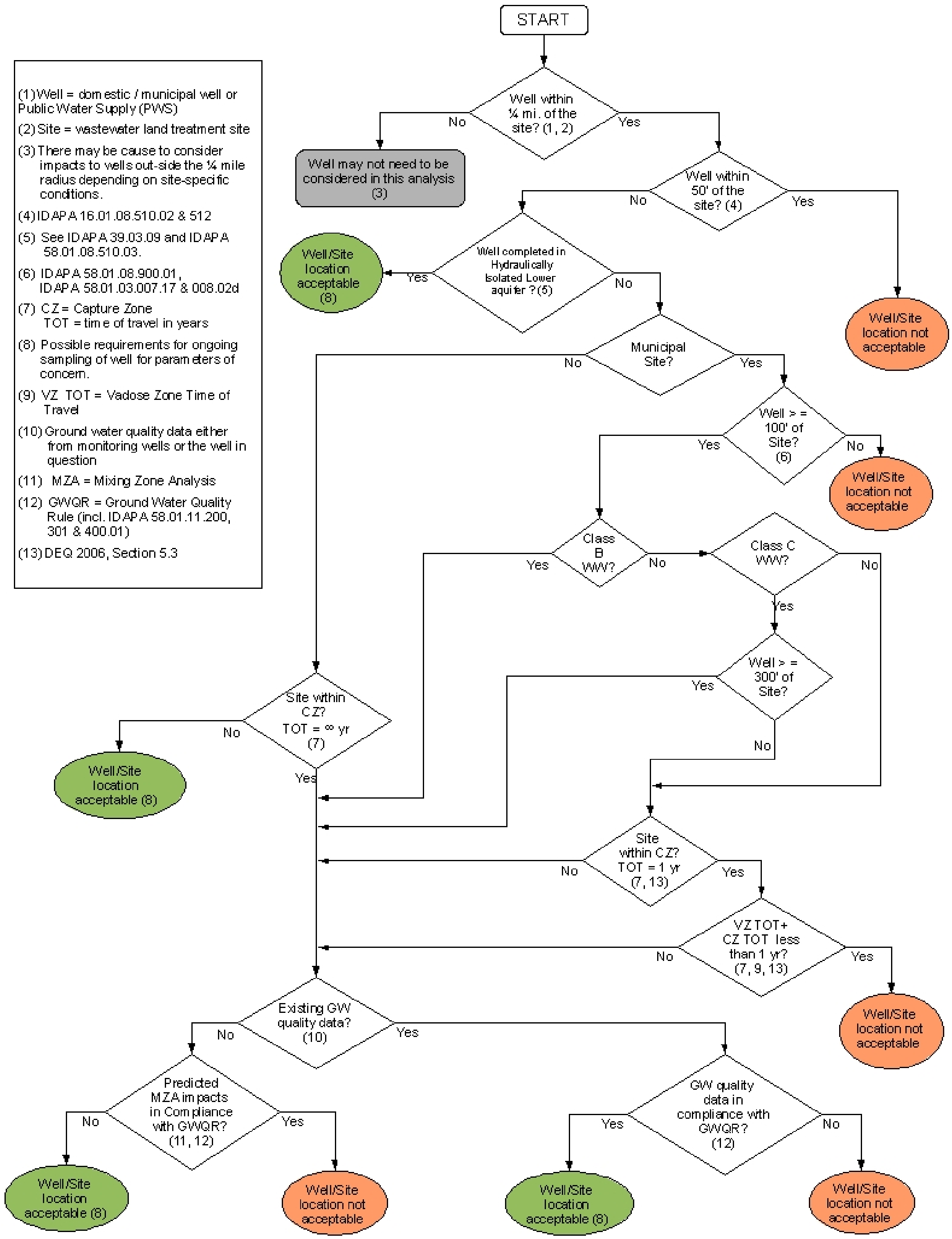

Figure 6-2. Well Location Acceptability Analysis.

6.7 Site Closure

Because protection of public health and the existing and future beneficial uses of the waters of the state must be maintained after site closure, permanent closure of a wastewater land treatment site often necessitates a closure plan. Accordingly, a site closure plan should be included as part of the submittal package for each *new* wastewater land application facility. Updated closure plans should be submitted by permittees at the time of permit renewal.

The closure plan should include an environmental assessment of possible adverse impacts resulting from the prior permitted facility and the decommissioning of pumps, storage lagoons and other equipment; a description of the planned treatment of sludge or wastewater in the lagoons; plans for site restoration; plans for the containment of soils with high-phosphorus levels; and any other necessary corrective actions.

DEQ makes the following recommendations regarding site closure for a wastewater-land application system:

- Site closure is included as a standard permit condition for each wastewater-land application facility.
- The standard permit condition includes two elements:
    - Permittee notification to DEQ six months prior to closure or as far in advance of closure as possible
    - A pre-site closure meeting between the permittee and DEQ, during which specific closure or clean-up tasks will be identified, along with time-lines for completion of tasks for both DEQ and the permittee.
- A site closure plan should be developed by the permittee based on the agreements and results of the pre-site closure meeting. The plan should be submitted to DEQ within 45 days after the pre-site closure meeting and finalized with signatory agreement by all parties prior to commencing site closure activities.

6.8 Weed Control at Wastewater Land Treatment Facilities

Weed control is a necessary practice at wastewater land treatment facilities. Facilities should manage their sites to control weeds, including noxious weeds. Procedures to address control of noxious weeds should be included in the facility plan of operation or O&M manual. DEQ should be kept informed of proposed plans for noxious weeds, because these plans may affect the performance of land application sites.

Lagoon areas should be free of weeds. Vegetation surrounding lagoons, if present, should be controlled for reasons discussed in Section 6.3.4.1. Weed control is also necessary on wastewater land treatment sites. Crops, which beneficially utilize water and nutrients, grow best when not in competition with weedy species.

It is important for facilities to be aware of the Idaho Noxious Weed Law, which is administered by the Idaho State Department of Agriculture (ISDA) under ISDA Noxious Weed Program. The following Web site provides information regarding noxious weeds found in Idaho, ISDA rules and requirements regarding noxious weeds, county contacts to discuss how to deal with noxious weeds, and other related information:

http://www.agri.state.id.us/Categories/PlantsInsects/NoxiousWeeds/indexnoxweedmain.php

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